

Engineering Clean Air

E-Newsletter Brought to You by Purafil Technical Services

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Purafil's scientists and researchers publish this monthly e-newsletter specifically for the engineering community. This exclusive newsletter will include information and explanations on the latest technology changes, regulations, standards, solutions, research findings and other information of value to consulting and specifying engineers.

Please feel free to forward to your engineering colleagues and have them join the Engineering Clean Air e-newsletter community by clicking the link to the right.

Sincerely,
Technical Services Department
Purafil, Inc.

About Purafil, Inc.

For more than 40 years, Purafil has been a world leader in the development of gas-phase air filtration media and systems designed to eliminate and control gaseous contaminants. We were the first to propose standards for industrial facilities using electronic process controls. Today, these standards are used worldwide.

Purafil offers the widest variety of gas-phase air filtration media and award-winning systems for the control of any Indoor Air Quality (IAQ) challenge. Purafil provides engineered, clean air solutions in an array of markets including commercial, industrial, water wastewater, museums and cleanrooms. Purafil's dry-chemical air cleaning media removes specific gases and contaminants from high-volume facilities in order to control corrosion, improve process reliability and IAQ, as well as save money.

Purafil's state-of-the-art laboratory and research facility offers valuable customer services, such as media life analysis, air quality assessment, and circuit board failure evaluation. In addition to those valued process, Purafil also offers a variety of technical services to ensure clean air and customer satisfaction. Purafil's ongoing commitment to quality, customer satisfaction and safety are exemplified by earning the latest ISO 9001:2008 certification, numerous industry awards and an obligation to the research and development of new clean air technologies.

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Carbon Dioxide Monitoring: IAQ Indicator or Just Another "Boy Who Cried Wolf?"



Carbon dioxide (CO₂) concentration has been and continues to be widely used as a surrogate indicator of indoor air quality (IAQ) in buildings, and the use of CO₂ measurements as a diagnostic tool in evaluating the performance and condition of HVAC systems is expanding. It had been suggested by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) that comfort criteria, described as the absence of odors, are likely to be satisfied when the concentration of CO₂ is below a certain threshold level. However, this use of CO₂ monitoring has been under increasing criticism in recent years.

It is being discussed within ASHRAE, and other professional organizations, that CO₂ should not be used as an IAQ indicator but rather as an occupancy indicator for demand controlled ventilation system designs. While CO₂ measurements are important as an indicator of the ventilation effectiveness for occupied buildings, they fail to give adequate information to properly control IAQ. This is because CO₂ is **NOT** a contaminant of concern to IAQ as interpreted by ASHRAE S556.1, the technical committee responsible for the continuous maintenance of ASHRAE Standard 62.1-2010: *Ventilation for Acceptable Indoor Air Quality*.

The monitoring of CO₂ levels in indoor air should be used only as one part in determining the effectiveness of a ventilation strategy in compliance with IAQ standards and guidelines. However, CO₂ levels should never be used as the sole determinant of the acceptability or unacceptability of the indoor environment, especially in those urban areas where the outside air does not meet local or national air quality standards. Too many times buildings experiencing IAQ problems have been given a clean bill-of-health based on levels of CO₂ alone. This does the building occupants little good when faced with continuing IAQ complaints.

Because there are literally thousands of chemical contaminants which may be present in the indoor environment – both from indoor and outdoor sources - one cannot assume that controlling one contaminant will control all. CO₂ levels suggested by some may be more accurately thought of as action levels as opposed to IAQ acceptance criteria. Gas-phase, or dry-scrubbing, air filtration is recognized as one method of providing acceptable air quality for IAQ regardless of the acceptance criteria used.

INTRODUCTION

It is assumed that the "best" air is that which is of naturally occurring composition in the absence of any effects of man or man-made processes and in the absence of any natural pollutants. Thus, an idealized air pollution control strategy would attempt to achieve the naturally occurring composition of the air and to remove all pollutants. This is not saying that this level of pollution control is necessary, feasible, or even desirable: rather, that if one could achieve this objective, there would be no further way to improve the air quality.

IAQ is a function of many parameters – including outdoor air quality and the presence of interior sources of contaminants. Indoor air should not contain contaminants in concentrations known to cause discomfort

or adverse health effects to occupants. Such contaminants include various gases, vapors, and smoke. These may be present in the makeup air or be introduced through indoor activities, by building materials and furnishings, surface coatings, and even the human occupants themselves.

CARBON DIOXIDE AND IAQ

The one contaminant that can be directly attributable to human occupancy of a building is the production of carbon dioxide gas (CO₂). CO₂ concentration has been widely used as a surrogate indicator of IAQ, and the use of CO₂ measurements as a diagnostic tool in evaluating the performance and condition of heating, ventilating, and air-conditioning (HVAC) systems is expanding. It has been suggested by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) that comfort criteria, described as the absence of odors, are likely to be satisfied when the concentration of CO₂ is less than 700 parts per million (ppm) above outdoor concentrations. However, the use of CO₂ as the sole indicator of IAQ has come under increasing criticism in recent years.

It is being argued in ASHRAE, and other professional organizations, that CO₂ should not be used as an indicator of acceptable/unacceptable IAQ. While CO₂ measurements are important as an indicator of the ventilation effectiveness and occupancy levels in buildings, they fail to give adequate information to properly control IAQ. This is because CO₂ is NOT considered to be a contaminant of concern to IAQ - especially in those urban areas where the outside air does not meet the National Primary Ambient Air Quality Standards (NAAQS) as set by the U.S. Environmental Protection Agency (TABLE 1).

TABLE 1. Current National Ambient Air Quality Standards (U.S. EPA) [1]

Pollutant	Primary Standards		Secondary Standards	
	Level	Averaging Time	Level	Averaging Time
Carbon Monoxide	9 ppm (10 mg/m ³)	8-hour ⁽¹⁾	None	
	35 ppm (40 mg/m ³)	1-hour ⁽¹⁾		
Lead	0.15 µg/m ³ ⁽²⁾	Rolling 3-Month Average	Same as Primary	
Nitrogen Dioxide	53 ppb* ⁽³⁾	Annual (Arithmetic Average)	Same as Primary	
	100 ppb	1-hour ⁽⁴⁾	None	
Particulate Matter (PM ₁₀)	150 µg/m ³	24-hour ⁽⁵⁾	Same as Primary	
Particulate Matter (PM _{2.5})	15.0 µg/m ³	Annual ⁽⁶⁾ (Arithmetic Average)	Same as Primary	
	35 µg/m ³	24-hour ⁽⁷⁾	Same as Primary	
Ozone	0.075 ppm (2008 std)	8-hour ⁽⁸⁾	Same as Primary	
	0.08 ppm (1997 std)	8-hour ⁽⁹⁾	Same as Primary	
	0.12 ppm	1-hour ⁽¹⁰⁾	Same as Primary	
Sulfur Dioxide	0.03 ppm	Annual (Arithmetic Average)	0.5 ppm	3-hour ⁽¹⁾
	0.14 ppm	24-hour ⁽¹⁾		
	75 ppb ⁽¹¹⁾	1-hour	None	

* parts per billion - 1000 ppb = 1 ppm

In recent years, a number of other indoor, and outdoor, air contaminants have received increased attention and emphasis. Formaldehyde, volatile organic compounds (VOCs), and combustion gases are those most commonly cited as contributors to such IAQ-related problems as sick-building syndrome (SBS) and building-related illnesses (BRI). ASHRAE acknowledges this by presenting a number of other contaminants and suggested control levels (TABLE 2).

TABLE 2. Additional Air Quality Standards (ASHRAE)

Contaminant	Standard Concentration	
Acetone	7 mg/m ³	2.95 ppm
Acrolein	25 µg/m ³	10.90 ppb
Ammonia	0.5 mg/m ³	0.72 ppm
Carbon dioxide	1800 mg/m ³	1000 ppm
Carbon disulfide	0.15 mg/m ³	48.17 ppb
Cresol	0.1 mg/m ³	22.61 ppb
Formaldehyde	150 µg/m ³	1.22 ppm
Hydrogen sulfide	40-50 µg/m ³	25-35 ppb
Nitric oxide	0.5 mg/m ³	0.41 ppb
Phenol	0.1 mg/m ³	25.98 ppb

ASHRAE STANDARD 62

One of the first attempts to establish methods of providing acceptable IAQ was ASHRAE's Standard 62-73, "Standard for Natural and Mechanical Ventilation." [2] This standard provided a prescriptive approach to ventilation by specifying both minimum and recommended outdoor air flow rates to obtain acceptable IAQ for a variety of indoor applications.

The revised Standard 62-1981, "Ventilation for Acceptable Indoor Air Quality," [3] recommended outdoor air flow rates for smoking and non-smoking conditions in most occupied spaces. This standard also offered an alternative air quality procedure to allow for the use of innovative energy conservation practices. This procedure allowed for the use of whatever amount of outside air deemed necessary if it could be shown that the levels of indoor air contaminants could be maintained below recommended limits.

The third revision of the standard, Standard 62-1989 [4], retained these two procedures for ventilation design, i.e., the Ventilation Rate and the IAQ Procedures. This standard endeavors to achieve the necessary balance between energy consumption and IAQ by specifying minimum ventilation rates and IAQ that will be acceptable to human occupants. These two procedures, however, approached IAQ and energy conservation from different perspectives.

The Ventilation Rate Procedure (VRP) defined the rate at which ventilation air must be delivered to a space, as well as various approaches to conditioning the incoming air. The IAQ Procedure provided a direct solution by reducing and controlling contaminant concentrations through air cleaning to specified acceptable levels. The IAQ Procedure allowed the amount of outside ventilation air to be reduced below standard levels if it can be demonstrated that the resulting air quality meets the required criteria.

The VRP provides only an indirect solution for the control of indoor contaminants. While it does allow for the use of cleaned, recirculated air, it does not allow using this air to reduce the amount of outdoor air specified in the standard. If this air is to be used to reduce the amount of outdoor air required for the implementation of energy conservation measures, the Indoor Air Quality (IAQ) Procedure must be used.

For example, when buildings' systems are shut down during a night or weekend set-back, pollutants other than CO₂ can build up - especially internally-generated contaminants such as volatile organic compounds (VOCs). If a monitoring system is sensing only CO₂, these other contaminants will not be flushed from the building until the next morning or the beginning of a new work week. VOC levels may actually take 2-3 days to return to "normal" baseline levels after a weekend set-back and past midday when night set-backs are used. Even when ventilation rates are increased during the day, if indoor CO₂ levels exceed "recommended" maximums, this may not occur until well into the day and those contaminants that had built up overnight or over the weekend are still at levels high enough to cause IAQ concerns. Increasing the ventilation rates to control CO₂ levels does not guarantee control of contaminants and many times only winds up substituting one group of contaminants (outside air) for another (internally-generated).

The IAQ Procedure provides a direct solution by reducing and controlling the concentrations of contaminants, through air cleaning, to specified acceptable levels. This procedure allows for both quantitative and subjective evaluation of the effectiveness of the air cleaning method(s) employed. The

standard acknowledges that air-cleaning, along with recirculation, is an effective means for controlling contaminants when using the Indoor Air Quality Procedure. Employing this procedure allows the amount of outside ventilation air to be reduced below standard levels if it can be demonstrated that the resulting air quality meets the required criteria.

Standard 62.1-2010. Previous versions of Standard 62 strived to achieve a balance between energy consumption and IAQ. Whereas the VRP focused primarily on achieving acceptable IAQ, the IAQ Procedure was intended to provide a way to reduce HVAC system operating costs while still providing a healthy environment. It went on to state that if the outdoor air contaminant levels exceed those listed in the Ambient Air Quality Standards, this air should be treated to control the offending contaminants. There was never a requirement or reference for either the direct or indirect control of CO₂ or any other contaminant that might have been present in the outdoor air – even if levels were higher than what would be considered acceptable with regards to IAQ. In fact there is no mention of CO₂ in the normative part of Standard 62.1 – much less a recommended control level – until Section 6.2.7.1 on Demand Control Ventilation (DCV) and its use as an optional means of dynamic reset for the outdoor air intake flow and/or space or ventilation zone airflow as HVAC operating conditions change.

In its current form, ASHRAE Standard 62.1-2010 [5], there is a requirement for the use of gaseous air cleaning when the outdoor particulates and ozone concentrations are high, but it does not yet require air cleaning for other gaseous contaminants. Mandatory air cleaning for ozone is appropriate because of the large number of people living in non-attainment areas, that is, locations where the outdoor ozone levels exceed national air quality standards, and the negative impact that ozone has on indoor air quality and occupant well-being. According to a listing of non-attainment areas close to half of the population of the US live in ozone non-attainment areas [6]. Note that while reducing the ozone concentration indoors may have a beneficial health effect; this requirement is primarily intended to reduce discomfort by reducing irritation due to ozone and its oxidation byproducts.

Standard 62.1 also limits the applicability of the VRP for energy conservation purposes to the use of recommended ventilation rates and measures other than reducing outside air. This includes efficient location of supply and return air devices, variable ventilation rates based on occupancy indicators, insulation of HVAC system components, sub-cooling of refrigerants, and other techniques [7,8,9].

The IAQ Procedure provides an alternate, performance-based design approach in which outdoor air intake rates and other system design parameters are based on an analysis of contaminant sources, contaminant concentration targets, and perceived acceptability targets. The IAQ Procedure allows credit to be taken – in the form of a reduction of the outside air intake rate(s) – for controls that remove contaminants or for other design techniques that can be reliably demonstrated to result in indoor contaminant concentrations equal to or lower than those achieved using the VRP. The IAQ Procedure may also be used where the design is intended to attain specific target contaminant concentrations or levels of acceptability of perceived indoor air quality.

The standard acknowledges that air cleaning, along with recirculation, is an effective means for controlling indoor levels of contaminants. Employing the IAQ procedure allows the amount of outside ventilation air to be reduced below levels prescribed by the VRP. And although the VRP does allow for the use of cleaned, recirculated air, it does not allow using this air to reduce the amount of outdoor air specified in the standard. If this air is to be used to reduce the amount of outdoor air required, or for the implementation of energy conservation measures, the IAQ Procedure must be used.

It was stated earlier that this standard tries to achieve a balance between energy consumption and IAQ. Whereas the Ventilation Rate Procedure focuses primarily on assuring acceptable IAQ, the IAQ Procedure is intended to provide a way to reduce HVAC system operating costs while still providing a healthy environment. These cost reductions come in the form of energy savings due to the decreased demands on the HVAC system, and can be quite substantial. In addition, many power companies offer rebates or grants for the implementation of such energy-saving measures.

SOLUTIONS TO IAQ PROBLEMS

The main acceptance criterion for this standard is still subjective in nature, i.e., the absence of odors. This means that just by controlling CO₂ levels to, e.g., below 1000 ppm, will not necessarily meet this criteria.

The fact that many IAQ-related complaints are based solely on odor, means that many problems may be reduced by ventilation alone, but not wholly eliminated. CO₂ is an odorless gas, therefore, its presence or absence cannot not be detected without dedicated monitoring equipment. However, we carry the most sensitive gas monitoring equipment with us all the time – the human nose. We can detect odors at concentrations which are essentially undetectable with standard monitoring instrumentation and are, at times, many orders of magnitude less than levels considered deleterious to human health. This is shown in TABLE 3.

TABLE 3. Threshold Values of Selected Compounds [10]

Contaminant Class	Representative Compound	Threshold Limit Value (TLV, ppm)*	IAQ Action Level (ppm)	Odor Threshold (ppm)
Aldehydes	Formaldehyde	0.3	1.22	1.0
	Acrolein	0.1	0.0109	0.2-15
Carbon dioxide	Carbon dioxide	5000	1000	n.a.
Carbon monoxide	Carbon monoxide	25.0	8.72	n.a.
Hydrocarbons	Acetone	750	2.95	100
	Benzene	10.0	n.a.	4.68
	Toluene	50	n.a.	2.14-15.0
	Cresol	5.0	0.0226	0.001-0.68
	Phenol	5.0	0.026	0.047-5
Oxides of nitrogen	Nitrogen dioxide	3.0	0.0643	5.0
Nitric oxide		25	0.041	0.3-1.0
Oxides of sulfur	Sulfur dioxide	2.0	0.0305	0.47-5.0
Organic acids	Acetic acid	10.0	n.a.	0.2-2.4
	Formic acid	5.0	n.a.	21
Others	Ammonia	25.0	0.72	1-46.8
	Carbon disulfide	10.0	0.0482	0.0011-7.7
	Hydrogen cyanide	10.0	n.a.	1.0
	Hydrogen sulfide	10.0	0.03	0.00047-4.6
	Ozone	0.1	0.12	0.1

*Based on 1993-1994 Threshold Limits Values for Chemical Substances and Physical Agents, American Conference of Governmental Industrial Hygienists

When compliance with the ventilation requirements of the standard does not provide adequate control of gaseous contaminants, methods based on sorption, with or without oxidation, may be employed. Such methods may be tailored to deal with a specific contaminant or group of contaminants. Many times, however, the exact contaminant makeup of the air is not known. Therefore, the use of a broad-spectrum contaminant removal strategy is the most effective and feasible gaseous contaminant control strategy. Through the use of gas-phase, or dry-scrubbing, air filtration media, gas cleaning systems can provide essentially contaminant-free air to use for recirculation and to reduce the amount of outside air. For the majority of IAQ applications, the use of two different media is indicated. These would be [Purafil SP](#) and [Purakol®](#) brand activated carbon. The media may be used together as individual filter sections in a complete system, or as a single blended product ([SP Blend](#)). Either way, in a properly designed and maintained gas-phase air filtration system, these media will be effective in removing those gaseous chemical contaminants known to be causes of unacceptable IAQ.

SUMMARY

The monitoring of carbon dioxide levels in indoor air should be used as only one part in determining the effectiveness of a ventilation strategy for compliance with ASHRAE Standard 62.1-2010. However, CO₂ levels should not be used as the sole determinant of the acceptability or unacceptability of the indoor environment. Too many times buildings experiencing SBS are given a clean bill-of-health based on CO₂ levels alone. This does the building owners/managers little good when faced with continuing IAQ complaints.

Because there are literally thousands of chemical contaminants which may be present in the indoor environment –both from indoor and outdoor sources – one cannot assume that controlling one

contaminant will control all. A target CO₂ level may be more accurately thought of as an action level as opposed to an IAQ acceptance criterion (note the OSHA TLV for carbon dioxide shown in Table 3). Purafil gas-phase, or dry-scrubbing, air filtration is recognized as one method of providing air of such quality that it would be acceptable for IAQ regardless of the acceptance criteria used.

Reduction in the amount of outside air is provided for in the standard when using proper air-cleaning techniques. This allows for a reduction in energy costs in addition to the benefit of maintaining, or improving, IAQ. Implementing energy-conservation programs in accordance with the provisions of ASHRAE Standard 62.1-2010 provides value for all parties concerned – the building owners and managers, as well as the occupants.

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Related Links/Information/Events

2011 American Filtration and Separation Society (AFS) Annual Conference, May 9-12, Louisville, Kentucky – The AFS is North America’s premier organization dedicated to separation technology. The AFS conferences and events bring together technology leaders from industry and educational institutions for the benefit of industrial process development, health and environment.

Over the past two years, over 330 organizations have sent representatives to AFS events to benefit from the wide range of possibilities offered, to extent and interchange knowledge on novel separation R&D. This is evidence of the trust in the excellence of the AFS and underlines the serious objective of the American Filtration Society to facilitate networking, customer contact and scientific interchange throughout all separation related technologies.

Even though the AFS is located in North America it spreads out to most of the continents of the world. Serious efforts in the past years have been rewarded with substantial networks in Asia, Europe and recently in South America leading to strong international representation at the AFS conferences.

Purafil will be presenting a paper titled “*Moving Closer to Net Zero Buildings with the IAQ Procedure of ASHRAE Standard 62.1-2010*” on Wednesday, May 11 at 11:25 AM.

2011 ASHRAE Annual Conference, June 25-29, Montreal PQ Canada - Bienvenue à Montréal, known for bringing a bit of European charm to North America. This is a city that blends cultures, languages and people from all over the world, culminating in a unique and vibrant joie de vivre.

In the same way, the 2011 ASHRAE Annual Conference will bring together members from all over the world to share their knowledge of HVAC&R. Their desire to create a more sustainable and energy efficient building industry surpasses language barriers and knows no borders. Vive la difference!

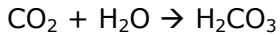
Purafil will be moderating a seminar on “*Mission Critical Data Centers: Keeping Contamination at Bay*” as well as presenting a paper titled “*Controlling Gaseous and Particulate Contamination in Data Centers*” on Monday, June 27 at 11:00 AM. The EU directive “on the Restriction of the use of certain Hazardous Substances in electrical and electronic equipment” (RoHS) was implemented in July 2006, and was the first of many similar regulations that have been passed. Research has shown that printed circuit boards made using lead-free materials can be more susceptible to corrosion and it has been reported that many lead-free products will creep corrode in high sulfur environments. Now data centers in many urban locations have reported failures of servers and hard disk drives due to sulfur corrosion. In the corrosion of electronic components, sulfur oxides, active sulfur compounds, oxides of nitrogen, and inorganic chlorides are the primary culprits. Particulates and gaseous contaminants can be drawn in through the building's air handling system(s) causing corrosion of electronics. This presentation will discuss application of gas-phase and particulate filtration for the data center environment. General aspects of data center design and air filtration technology will be presented with descriptions of various filters and systems and where these may be employed within the data center environment to provide for enhanced air cleaning.

Purafil will also be moderating a forum on “*Moving Closer to Net Zero Buildings with the IAQ Procedure of Standard 62.1-2010*” on Tuesday, June 28 at 9:45 AM. This forum presents and discusses the current status of the Indoor Air Quality Procedure of Standard 62.1-2010 - specifically as related to its potential for significant energy savings when used to determine outside air ventilation rates for HVAC systems. This forum solicits input as to what can be done to validate the IAQ Procedure and make it more useful to the engineering community when designing "net zero" energy buildings.

Contaminant of the Month

Carbon Dioxide (carbonic acid gas, carbonic anhydride, carbonic oxide, carbon oxide, carbon(IV) oxide, dry ice [solid phase], CO₂, molecular weight 44.01) is a chemical compound composed of two oxygen atoms covalently bonded to a single carbon atom. It is a gas at standard temperature and pressure and exists in Earth's atmosphere in this state. CO₂ is a trace gas comprising 0.039% of the atmosphere.

CO₂ is an acidic oxide: an aqueous solution turns litmus from blue to pink. It is the anhydride of carbonic acid, an acid which is unstable in aqueous solution, from which it cannot be concentrated. In organisms carbonic acid production is catalyzed by the enzyme, carbonic anhydrase.



CO₂ is toxic in higher concentrations: 1% (10,000 ppm) will make some people feel drowsy. Concentrations of 7% to 10% cause dizziness, headache, visual and hearing dysfunction, and unconsciousness within a few minutes to an hour.

The control of carbon dioxide is not possible using common dry-scrubbing media products. There are specialty products that can be used to remove CO₂ from the air, but they are costly and often require special handling. In most applications, proper ventilation is an effective and economical method to control elevated levels of this gas.

Purafil Solutions – EnerSAVE®



An increasing number of commercial buildings are employing energy conservation products and practices to cut energy costs. Heating, ventilation, and air-conditioning (HVAC) represents the largest energy use in commercial buildings. Unfortunately, cutting HVAC costs is often at the expense of indoor air quality (IAQ). History has proven that buildings with insufficient ventilation compromise the health of building occupants.

What is Enersave? Enersave uses the Indoor Air Quality Procedure in ASHRAE Standard 62.1 to cut energy costs by reducing outside ventilation air requirements and HVAC loads while at the same time directly controlling and improving IAQ.

By recirculating air that would previously have been exhausted and using Purafil's chemical filtration systems to keep air clean, Enersave also provides the documentation and ongoing verification reports needed for compliance. Through the use of Enersave one can realize substantial operational costs. To see if Enersave is right for your building or project, contact your local representative for an Enersave Calculation Request.

Use Enersave in Existing Buildings. Implement the IAQ Procedure with no additional capital expenses! Slide out your existing particulate filter and slide in the Purafilter for particulate and chemical filtration. For higher levels of gaseous contamination, insert a 2" or 4" PuraGRID filter in conjunction with your existing particulate filter. Cut costs even more by reducing the total demand on heating and cooling equipment. You'll save on operational costs, and the reduced demand will extend the life of your conditioning equipment.

Use Enersave in Rework Applications. For buildings undergoing occupancy changes or chiller redesign due to refrigerant changes, capital expenditures are often required to handle the increased outside air demand to meet ASHRAE 62's Ventilation Rate requirements. With Enersave, Purafil will replace the existing particulate filters with Purafilters or insert PuraGRIDs, evaluate the building, and provide the calculations and support necessary to comply with ASHRAE 62's IAQ Procedure.

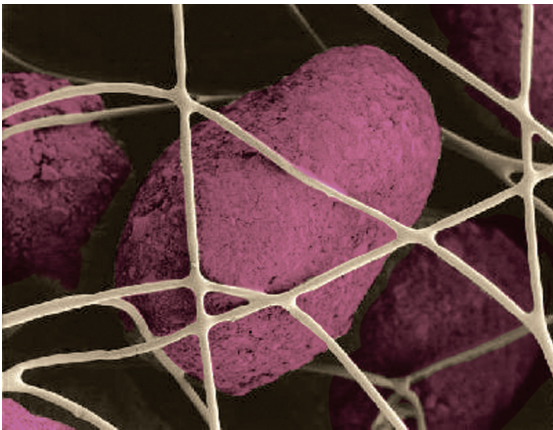
Use Enersave in New Construction. With Enersave, you can reduce overall equipment sizing for tremendous cost savings on capital purchases. Purafil offers a broad range of modular systems to meet your specific airflows, contaminant levels, and space requirements. Purafil will work with your construction engineers to assure the optimum balance of energy savings and proper ventilation required to handle the increased outside air demand to meet ASHRAE 62's Ventilation Rate requirements. With Enersave, Purafil will replace the existing particulate filters with Purafilters or insert PuraGRIDs, evaluate the building, and provide the calculations and support necessary to comply with ASHRAE 62's IAQ Procedure.

Green Technology



Dry-scrubbing chemical filtration media has been applied in many forms for the control of odors and indoor air pollutants. Many manufacturers have attempted to apply dry-scrubbing media to various pleatable filter substrates, but most processes being used cause the media to become “blinded” through the use of various binders, adhesives, and manufacturing techniques. Even the highest quality dry-scrubbing media will only be moderately successful if the path of entry for the contaminants to the internal structure of the medium particles is not optimized.

Physical limitations in HVAC system designs (e.g., available space, ΔP , costs) led to the development of the Purafilter line of chemical filtration products. In these products, one or more of Purafil’s dry-scrubbing media is applied to a non-woven fiber matrix in such a manner that provides a higher initial and average removal efficiency and lower pressure drop than competitive technologies. Service life for this product is comparable to granular media systems. This media also provides for filter design flexibility allowing easy application into new or existing HVAC systems. It is also the only product to successfully apply sodium permanganate adsorbents ([Purafil SP](#)) in a bi-component fiber matrix (magnified view below).



The Purafilter is a true combination chemical and particulate filter designed to replace existing particulate filters in new construction, retrofit or rework applications. Rated particulate filter efficiencies are available from MERV 8 (30%) to MERV 15 (95%) so that the desired level of particulate filtration is maintained while at the same time adding the capability to remove chemical contamination.

Purafilters come in all standard filter sizes in depths from 2 – 12” (50 – 100 mm) and are available as commercial grade, heavy duty/industrial grade, and cleanroom grade filters. The Purafilter-FFU meets the strictest product quality requirements for use in the most critical semiconductor and microelectronic manufacturing applications.

Companion Paper

[Demand-Controlled Ventilation Using CO₂ Sensors \(report sponsored by the United States Department of Energy, Energy Efficiency and Renewable Energy, Federal Energy Management Program\)](#)
